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**Program of Studies**  
**Elementary Schools (ECS – Grade 6)**

**Mathematics**

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**CURRICULUM BRANCH**

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# MATHEMATICS

## A. RATIONALE AND PHILOSOPHY

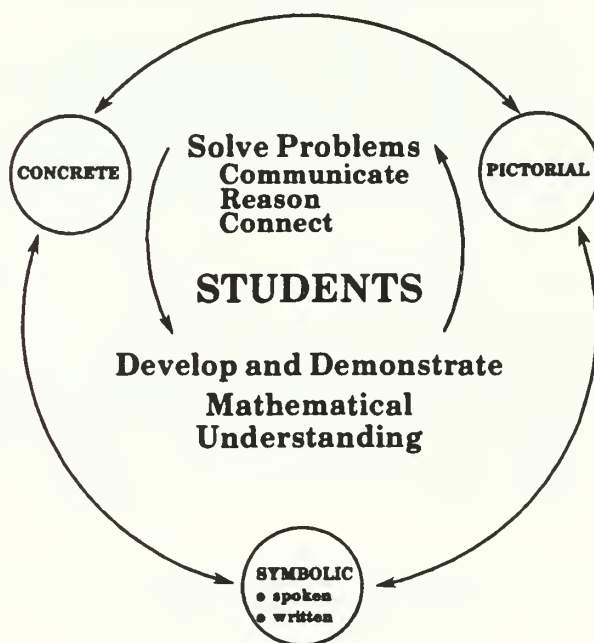
Mathematics plays an important role in all aspects of human endeavour. Whether one is buying groceries at the store or planning a trip, mathematics is necessary to understand the world and function in it. Learning mathematics helps students realize that it is a common and essential human activity.

As students study mathematics they understand and appreciate the quantitative and geometric nature of the world around them. They also develop the knowledge, skills and attitudes necessary for making appropriate decisions in daily life.

Students in all classrooms have different learning needs and abilities. They need to be able to develop their mathematical understanding at different rates and in different ways. Teaching decisions should therefore build upon what students already know and can do with mathematics.

Students develop and demonstrate mathematical understanding as they solve problems, communicate, reason and connect. This process links manipulatives (concrete mode), diagrams (pictorial mode), and spoken and written symbols (symbolic mode). In some cases, constructing mathematical knowledge may be a purely mental activity, such as extending a known pattern as in place value.

The interrelationships in learning mathematics are illustrated in the following diagram.



The mathematics component of the program of studies is built around a set of fundamental principles. These principles outline the elements essential to students' understanding of mathematics and other subjects. Teaching decisions are guided by these fundamental principles as well as by the general learner expectation and the specific learner expectations set out in this document.

## **Mathematics is learned and applied through solving problems.**

Students develop an understanding of concepts and realize the importance of mathematics when they solve problems that relate to their real-life experiences. Learning a new concept begins with problem situations that contain the key aspects of the new concept. As students solve the problems, they develop an understanding of the concept and the ability to reason. They are then able to apply this understanding to new problem situations.

## **Communication is essential for developing and demonstrating conceptual understanding.**

Students communicate and are actively engaged in learning when they use manipulatives (concrete mode), diagrams (pictorial mode), and spoken and written symbols (symbolic mode) to represent concepts.

Students develop and demonstrate an understanding of mathematics when they reflect upon, explain and defend their ideas orally and in writing. The mathematical language of signs, symbols and terms is developed and justified by connecting it to manipulatives and diagrams.

## **Reasoning is required for understanding mathematics.**

Reasoning means analyzing situations, drawing conclusions and justifying solution processes. As students reason, they understand that mathematics makes sense, is logical and is enjoyable.

## **Making connections is required for understanding mathematics.**

Students understand mathematics by connecting:

- what they already know with new learning
- mathematics to real-life problems
- the concrete, pictorial and symbolic modes of representation, that is, connecting concepts with symbols
- the various strands in mathematics
- mathematics with other curriculum areas.

## **Learning mathematics involves two related processes:**

- **developing understanding**
- **demonstrating understanding.**

Students develop mathematical understanding by deriving meaning from suitable experiences in the environment.

**Example.** By solving real-life multiplication problems using concrete, pictorial and symbolic connections, students understand that multiplication means putting together equal groups.

Students demonstrate mathematical understanding by applying their knowledge to solve real-life problems and justify their solutions.

**Example.** Students demonstrate their understanding of multiplication by solving multiplication problems and justifying their solution using symbolic, pictorial and concrete connections.

## **Integrating assessment with instruction is necessary to maximize the progress of each student.**

Assessment is an integral part of the learning process. Its purpose is to determine the knowledge and strategies that are used by students in solving problems. This information is then used to tailor instruction appropriate to the knowledge and abilities of the students.

Instruction that meets individual needs promotes students' understanding of mathematics. It nurtures the confidence necessary for taking risks, accepting challenges and making decisions.

## **Technology is changing mathematics learning.**

Appropriate use of calculators and/or computers enables students to solve a wider variety of real-life problems and focus more on developing mathematical understanding.

Students use estimation to determine the reasonableness of calculator and/or computer answers. Facility with number facts is necessary for developing estimating skills.



## B. GENERAL LEARNER EXPECTATION

The general learner expectation for mathematics is:

**Students are confident and increasingly competent in solving problems as they develop and demonstrate understanding of mathematical concepts, relationships and procedures.**

The general learner expectation provides the focus for students' mathematics learning in the elementary years. It encompasses the following critical dimensions:

- **Students are expected to demonstrate confidence in their mathematical abilities.**

As students develop an understanding of mathematical concepts, it is expected that they will demonstrate:

- a willingness to take risks and accept challenges
- a sense of accomplishment in mathematics
- a positive attitude toward mathematics learning.

- **Students are expected to demonstrate increasing competence in solving problems.**

Students learn new concepts by building on a solid foundation of previous understandings. Through the elementary years, students grow in their abilities to apply mathematics in solving real-life problems.

To be competent in solving problems, students must understand the interrelationships among the mathematical strands.

- **Students are expected to develop and demonstrate understanding of mathematics by solving problems, communicating, reasoning and connecting.**

To develop understanding, students build mathematical meaning by using previous knowledge to explore new ideas in problem situations. Students must use manipulatives and then connect them to diagrams and symbols in order to understand abstractions. Manipulatives are concrete representations of mathematical concepts and procedures.

**Example.** Students develop understanding of multiplication by using manipulatives and diagrams to solve multiplication problems. As they solve the problems, they abstract what is common to these situations and understand that multiplication means putting together equal groups. They then use appropriate spoken and written symbols to represent the concept, such as  $2 \times 3 = 6$ .

To demonstrate understanding, students apply their knowledge of mathematics to solve new problems and communicate why the solution is correct. This reverses the procedure. Students solve the new problems using symbols and verify the results by using diagrams and manipulatives, where appropriate.

**Example.** Students demonstrate their understanding of multiplication by selecting multiplication problems from a group of mixed problems. They solve these problems by using appropriate symbols, such as  $4 \times 5 = 20$ , and verify that the solution is correct by drawing a diagram or using manipulatives.

Two important aspects of learning mathematics that are not specifically stated in the general learner expectation include:

- **Students are expected to use technology, where appropriate.**

Students are expected to use technology, such as the calculator and/or computer, as an efficient means of developing concepts, exploring relationships and patterns, organizing and displaying data, and carrying out procedures to solve problems.

Estimation skills are crucial in determining the reasonableness of calculator and/or computer answers. Students must know number facts without hesitation to develop estimation skills.

- **Students are expected to develop psychomotor skills as they learn and apply mathematics.**

Psychomotor skills require a level of proficiency in hand-eye coordination. This is developed through:

- manipulation of objects
- construction of spatial figures
- drawing diagrams
- writing symbols.



## C. SPECIFIC LEARNER EXPECTATIONS

### STRUCTURE OF THE SPECIFIC LEARNER EXPECTATIONS

#### Levels of Learning

The specific learner expectations describe the developmental path of mathematics learning for children in the elementary years. This continuum is set out in eight levels that identify the learner's increasing competence in solving problems. Combinations of letters, numbers and lines are used throughout this section to identify the subparts of the continuum.

Because students differ from each other in their pace of learning or development, **the performance levels are considered independent of age or year in school.** Within any grade/year there may be students working at various levels in their understanding of mathematics.

Example. The majority of students in a Grade 4 classroom may be working at Level 6, but some students may be working at levels above or below this level.

Teachers need to use a variety of evaluation strategies to discern and describe their students' level of mathematics understanding. Based on such assessment, teachers should use the specific learner expectations to set learning goals appropriate to the particular needs of their students, and to design instruction suited to these needs and their students' learning styles.

#### Organization of the Specific Learner Expectations

Mathematics learning is an integrated process. For clarity, it has been described in strands, but should be integrated during instruction and learning. These strands are:

- numeration (N)
- operations and properties (O)
- measurement (M)
- geometry (G)
- data management (D).

Each specific learner expectation is identified by a letter and a number.

The students should understand the connections among the strands and the relationship between mathematics and other curriculum areas.

The expectations for problem solving (P) are outlined for each level and students are to achieve these by solving problems related to the concepts within the strands.

#### Developing and Demonstrating Mathematical Understanding

The specific learner expectations illustrate the related processes of developing and demonstrating mathematical understanding. As students solve problems, they use manipulatives and diagrams to develop understanding of concepts and connect this with the appropriate spoken and written symbols. Students then apply the knowledge learned to new problem situations and justify their solutions. They demonstrate understanding of spoken and written symbols by using manipulatives and diagrams.

For example, consider the specific learner expectation O-19:

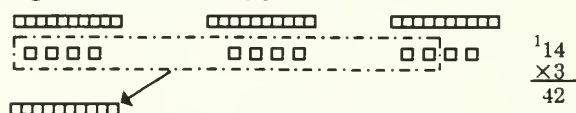
O-19. multiplies whole numbers in a problem-solving setting by:

- using manipulatives and diagrams to develop a paper-and-pencil method
- using a paper-and-pencil solution, and verifying it through the use of manipulatives and diagrams, where appropriate.

The first bullet above indicates that the students develop understanding of multiplication by solving a variety of problems that contain the multiplication concept.

Example. Lori Anne has three bags with fourteen marbles in each bag. How many marbles does she have?

To solve this problem, students use marbles and bags or other appropriate manipulatives, such as base-ten materials. They connect them to a diagram and written symbols.



The students discuss the connections among manipulatives, diagrams and written symbols. Through discussion of various examples, students develop understanding of multiplication and the associated symbols.

The second bullet reverses the procedure. The students demonstrate understanding of multiplication by using symbols to solve new multiplication problems. They verify their solution by using manipulatives and diagrams.

Students build their understanding of concepts on the basis of what they have already learned. As a result, the concepts learned at one level are either maintained or extended in subsequent levels. This cumulative nature of mathematics learning is described in the horizontal format as follows:

————— Solid lines indicate proficiency in understanding concepts. Where solid lines appear across more than one level, the lines indicate application of the concept at increasing levels of difficulty.

Example. The solid line in O-4 extends from Level 3 to Level 8. This means that students at all these levels demonstrate proficiency in symbolizing addition and subtraction situations. However, at Level 3 they use numbers to 10, at Level 4 they use numbers to 99 and so on.

The letters and numbers following solid or dotted lines connect the specific learner expectations.

Example. The symbols O-3 follow the solid line in O-2. Therefore, O-2 connects to O-3.

In some instances, the solid lines have been replaced with numbers or metric symbols (in parentheses) to indicate the specific level of difficulty expected of students.

Example. In O-6, the requirements for number facts are specified at Levels 3, 4 and 5.

..... Dotted lines indicate that students maintain the concept and apply it as needed.

Example. In O-6, proficiency in recalling addition and subtraction facts is maintained and used as needed after Level 5.

## SCOPE OF THE SPECIFIC LEARNER EXPECTATIONS

### Problem Solving

The primary focus of mathematics learning is on developing confidence and increasing competence in problem solving. Students need to learn many different skills and strategies that they can apply to a variety of new problem situations in which the means to the solution are not immediately evident. To facilitate this development, students must express a need or desire to solve problems and perseverance in carrying out the solutions.

As students learn the skills, strategies and attitudes associated with problem solving, they integrate the concepts within and across the strands.

Students need to develop four aspects of problem solving:

1. learning about how to solve problems
2. learning concepts through problem solving
3. applying the concepts learned to new problem situations
4. creating problems that exemplify the concepts learned.

### Learning about How to Solve Problems

Students learn about how to solve problems by using the stages in the problem-solving process:

- understanding the problem
- developing and carrying out the plan
- looking back.

They learn skills associated with each stage and understand a variety of strategies from which they can choose in developing and carrying out their problem-solving plans. Specific skills and strategies for each of the problem-solving stages are outlined for each level.

### Learning Concepts Through Problem Solving

Students learn a concept through problem solving when they begin with a problem that contains the key aspects of the concept. In this way mathematics learning develops by connecting real-life, problem-solving experiences with abstracting the concept. For example, students learn the meaning of multiplication and associated symbols by solving multiplication problems using concrete, pictorial and symbolic connections.

### Applying the Concepts Learned to New Problem Situations

Students use the mathematical understanding of concepts or procedures to interpret and solve new problem situations.

### Creating Problems that Exemplify the Concepts Learned

Students demonstrate understanding of concepts by creating new problem situations that exemplify these concepts.

### **Numeration**

Students develop and demonstrate understanding of patterns, place value, numbers (whole, decimal, fraction), number relationships (comparing, ordering, rounding) and estimation

of quantity. Numeration concepts are used in all the other strands.

### **Operations and Properties**

Students develop and demonstrate understanding of addition, subtraction, multiplication and division of whole numbers and decimals. Emphasis is placed on using a variety of methods to solve problems, including estimation, mental calculation, algorithms and the calculator or computer. This results in de-emphasizing time-consuming paper-and-pencil calculations.

Students use a variety of estimation strategies to develop number sense. Knowledge of number facts is essential for developing these strategies. An important use of estimation is determining the reasonableness of calculator and computer answers.

This strand also focuses on developing and demonstrating an understanding of the commutative, associative and distributive properties and the unique effect of 0 and 1. Knowledge of these properties enhances students' understanding of the operations and is essential in mental calculations.

### **Measurement**

Students develop and demonstrate understanding of time, length, capacity, mass, temperature, money, perimeter, area, volume and angles. Emphasis is placed on estimating prior to measuring. When the students estimate and then measure to check how close their estimate is, they deepen their understanding of the measurement process.

The successive stages in the measurement process include:

- making comparisons between objects
- comparing an object with a non-standard unit
- comparing an object with a standard unit
- choosing measurement units for specific tasks.



## **Geometry**

Students develop and demonstrate understanding of the attributes of geometric shapes and spatial relationships. Building on their intuitive understanding of concepts, students move from the concrete to the abstract. They study three-dimensional objects and two-dimensional figures through moving, sorting, classifying, constructing and describing. The connection between three-dimensional objects and two-dimensional figures is emphasized.

## **Data Management**

Students develop and demonstrate understanding of probability and statistics, including graphing. They explore the concepts of chance as they participate in probability experiments. In statistics, students collect, record, organize, display and interpret data in a variety of ways. Students learn how to use numbers to describe and interpret the world around them and to solve problems.

## PROBLEM SOLVING

### LEVELS

	1	2	3	4	5	6	7	8
The student:								
P-1. demonstrates willingness to find a solution to a problem								
P-2. perseveres in finding a solution to a problem								
P-3. demonstrates flexibility in finding solutions to problems								
P-4. presents ideas clearly								
P-5. works both independently and in a group situation.								
<b>Understanding the Problem</b>								
The student:								
P-6. understands words and phrases	oral	oral						
P-7. knows the question asked	oral	oral						
P-8. interprets pictures and diagrams								
P-9. identifies given information								
P-10. restates the problem in own words								
P-11. knows what information is implied								
P-12. knows what information is missing								
P-13. knows what information is extraneous.								
<b>Developing and Carrying Out the Plan</b>								
The student:								
P-14. uses logical reasoning								
P-15. acts it out								
P-16. uses manipulatives and trial-and-error								
P-17. looks for and continues patterns								

## PROBLEM SOLVING (continued)

### LEVELS

	1	2	3	4	5	6	7	8
<b>Developing and Carrying Out the Plan</b> (continued)								
P-18. draws pictures and diagrams								
P-19. collects and uses data:								
• tally								
• concrete graphs								
• pictographs								
• bar graphs								
• double bar graphs								
• line graphs								
P-20. chooses and carries out the appropriate operation, using an appropriate method (paper-and-pencil, mental calculation or calculator)								
P-21. does a simpler but related problem								
P-22. guesses and checks								
P-23. uses tables or lists								
P-24. monitors the process in carrying out the plan.								
<b>Looking Back</b>								
The student:								
P-25. states the answer(s) to the problem								
P-26. determines if the answer is reasonable								
P-27. discusses the solution process with others								
P-28. looks for other ways to solve the problem								
P-29. retells the problem with the solution								
P-30. does similar problems								
P-31. alters the problem and finds the effect								
P-32. generalizes the solution.								



# NUMERATION

## LEVELS

	1	2	3	4	5	6	7	8
<b>Patterns</b>								
The student:								
N-1. spontaneously creates rhythmic patterns	N-2							
N-2. exhibits awareness of patterns by using action and manipulatives: <ul style="list-style-type: none"> <li>creates and identifies patterns</li> <li>reproduces and extends a simple pattern</li> </ul>		N-3						
N-3. demonstrates understanding of patterns by: <ul style="list-style-type: none"> <li>creating and identifying patterns</li> <li>reproducing and extending a pattern</li> <li>translating a pattern into a different form (medium)</li> <li>comparing the similarities and differences of patterns</li> </ul>								
N-4. exhibits awareness of the characteristics of odd and even numbers by using manipulatives and a calculator				(0-100)	(0-1 000)			
N-5. uses manipulatives, diagrams, symbols and the calculator to identify multiples by counting by:			(10s)	(2s, 5s, 10s, 100s)	(2s, 5s, 10s, 25s, 100s)			
<b>Whole Numbers, Decimals, Place Value</b>								
The student:								
N-6. demonstrates understanding of sets by: <ul style="list-style-type: none"> <li>sometimes sorting objects according to one attribute; e.g., colour, or past experiences with functions of objects</li> <li>using words denoting quantity; e.g., many, not very many</li> <li>matching two sets of related objects (one-to-one correspondence; e.g., cups and saucers)</li> </ul>								

## NUMERATION (continued)

### Whole Numbers, Decimals, Place Value (continued)

- sorting objects according to attributes, and describing these attributes
- matching members of two sets of manipulatives, and describing the relationships using the terms: more than, less than, the same as (no written symbols)
- matching two sets of manipulatives or pictures, and describing the relationships using the terms: greater than, fewer, equal to (no written symbols)

N-7. demonstrates understanding of number relationships through exploring the arrangements and combinations of sets of objects; e.g., 6 is one more than 5, one less than 7, 2 groups of 3, 3 groups of 2

N-8. demonstrates understanding of numbers by:

- counting a set of objects
- associating a numeral with a set of objects or pictures
- reading and writing the numerals shown by manipulatives and diagrams, where appropriate
- using manipulatives or drawing diagrams to represent spoken and written numerals, where appropriate
- writing number words and connecting them with manipulatives and diagrams, where appropriate

N-9. groups a set of objects (up to 100) into groups of 10, and names the number in the set

LEVELS									
1	2	3	4	5	6	7	8		
	<u>        </u> G-5								
	<u>        </u>								
		<u>        </u> N-15							
		(0-10)	(0-100)						
(1-2)	(1-9) (1-9)	(0-100)							
		(0-100)	(0-999)	(tenths to thousands)	(hundredths to ten thousands)	(thousandths to hundred thousands)	(thousandths to billions)		
			<u>        </u> N-10						

# NUMERATION (continued)

## Whole Numbers, Decimals, Place Value (continued)

## LEVELS

	1	2	3	4	5	6	7	8
N-10. demonstrates understanding of the relationship among place values, including regrouping, by connecting: <ul style="list-style-type: none"> <li>spoken and written symbols to manipulatives and diagrams, where appropriate</li> <li>manipulatives and diagrams to spoken and written symbols, where appropriate</li> </ul>				(1s, 10s, 100s)	(tenths to thousands)	(hundredths to ten thousands)	(thousandths to hundred thousands)	(thousandths to billions)
N-11. demonstrates understanding of equivalent decimals by: <ul style="list-style-type: none"> <li>reading and writing the equivalent decimals shown by manipulatives and diagrams</li> <li>generating equivalent decimals in symbolic form, and verifying their equivalence using manipulatives and diagrams</li> </ul>						(tenths, hundredths)	(tenths, hundredths, thousandths)	.....
N-12. identifies and names the place value of digits by connecting concrete, pictorial and symbolic representations, where appropriate				(0-999)	(tenths to thousands)	(hundredths to ten thousands)	(thousandths to hundred thousands)	(thousandths to billions)
N-13. writes numbers in expanded notation and vice versa, and connects these symbols to concrete and pictorial representations, where appropriate					(0-9 999)	(0-99 999)	(0-999 999)	(thousandths to billions)
N-14. names and uses ordinals				(first to tenth)	(first to hundredth)	.....	.....	.....
N-15. demonstrates understanding of ordering numbers by: <ul style="list-style-type: none"> <li>ordering sets of objects</li> </ul>		(1-9)						



# NUMERATION (continued)

## Whole Numbers, Decimals, Place Value (continued)

- ordering sets of objects or diagrams, and connecting spoken and written numerals to the sets, where appropriate
- ordering spoken and written numerals, and using objects and diagrams to show that the order is correct, where appropriate
- using symbols  $>$ ,  $<$ ,  $=$

N-16. demonstrates understanding of rounding whole numbers in a meaningful context by connecting concrete, pictorial and symbolic representations, where appropriate

N-17. demonstrates understanding of rounding decimals in a meaningful context by connecting concrete, pictorial and symbolic representations, where appropriate

N-18. estimates the number of objects, counts them, and compares the result to the estimate.

## Fractions

The student:

N-19. exhibits awareness of the fraction concept of halves as representing part of a region by using manipulatives

N-20. demonstrates understanding of proper fractions as representing part of a region or part of a set by:

- reading and writing fractions shown by manipulatives and diagrams
- using manipulatives or diagrams to represent spoken and written fractions

## LEVELS

1	2	3	4	5	6	7	8
		(0-10)	(0-100)	(0-1 000)	(hundredths to ten thousands)	(thousandths to hundred thousands)	(thousandths to billions)
					(limit: to the nearest thousand)	(limit: to the nearest ten thousand)	(limit: to the nearest hundred thousand million)
					(limit: to the nearest whole number)	(limit: to the nearest hundredth)	.....
		(0-50)	(0-100)	(0-500)	(0-1 000)	.....	.....
			N-20				
			(halves, thirds, quarters)	(halves, thirds, quarters, fifths, tenths)	(halves, thirds, quarters, fifths, tenths, hundredths on number line)	.....	.....

## NUMERATION (continued)

### LEVELS

	1	2	3	4	5	6	7	8
<b>Fractions (continued)</b>								
N-21. demonstrates understanding of the relationship between fractions and decimals by connecting manipulatives, diagrams and symbols					(tenths)	(tenths, hundredths)	(tenths to thousandths)	.....
N-22. demonstrates understanding of equivalent fractions (emphasis on halves, quarters, fifths, tenths, hundredths) in a problem-solving setting by: <ul style="list-style-type: none"> <li>● reading and writing equivalent fractions shown by manipulatives and diagrams</li> <li>● generating equivalent fractions in symbolic form, and verifying their equivalence using manipulatives and diagrams</li> </ul>								.....
N-23. compares proper fractions (emphasis on halves, quarters, fifths, tenths, hundredths) by using:						(manipulatives and diagrams)	.....	(equivalent fractions)
N-24. demonstrates understanding of halves, quarters and fifths as fractions and decimals by connecting manipulatives, diagrams and symbols and by using the calculator.								
<b>Ratios</b>								
The student:								
N-25. demonstrates understanding of ratios by: <ul style="list-style-type: none"> <li>● reading and writing the ratios (a:b, a to b, <math>\frac{a}{b}</math>) shown by manipulatives and diagrams</li> <li>● using manipulatives or diagrams to represent spoken and written ratios</li> </ul>								

## NUMERATION (continued)




### LEVELS

	1	2	3	4	5	6	7	8
<b>Ratios (continued)</b>								
N-26. demonstrates understanding of per cent as a ratio by connecting concrete, pictorial and symbolic representations								
N-27. uses manipulatives and diagrams to generate equivalent ratios, and connects these representations to the appropriate spoken and written symbols in a problem-solving setting.								
<b>Integers</b>								
The student:								
N-28. uses integers in real-life applications								
N-29. demonstrates understanding of ordering integers and using the symbols $>$ , $<$ and $=$ by connecting spoken and written symbols to representations on a number line.								



# OPERATIONS AND PROPERTIES

## LEVELS

	1	2	3	4	5	6	7	8
<b>Addition and Subtraction of Whole Numbers</b> The student:								
O-1. combines and separates sets of objects but may not understand that the whole is greater than the part								
O-2. exhibits awareness of the processes of addition and subtraction through role playing and the use of manipulatives in a problem-solving setting								
O-3. demonstrates understanding of the processes of addition (joining) and subtraction (taking away, missing addend, comparison) by using manipulatives and diagrams in a problem-solving setting								
O-4. symbolizes addition and subtraction situations								
O-5. demonstrates understanding of addition and subtraction facts, using appropriate strategies in a problem-solving setting			(to 10)	(to 18)	.....	.....	.....	.....
O-6. recalls addition and subtraction facts without hesitation			(adding or subtracting 0 or 1: limit to 10)	(to 10)	(to 18)	.....	.....	.....
O-7. estimates sums and differences in a meaningful context by using:				(sums and minuends to 99)	(any two- and three-digit numbers)	(limit: four-digit numbers)	(limit: five-digit numbers)	(any whole numbers)
● the front-end method								
● compensation								
● rounding								
● clustering/averaging								

(continued)

(continued)

## LEVELS

# OPERATIONS AND PROPERTIES (continued)

## LEVELS

	1	2	3	4	5	6	7	8
<b>Multiplication and Division of Whole Numbers (continued)</b>								
O-12. demonstrates understanding of multiplication and division facts, using appropriate strategies in a problem-solving setting					(to 45)	(to 81)	.....	.....
O-13. recalls multiplication and division facts without hesitation						(to 45)	(to 81)	.....
O-14. multiplies one-digit whole numbers mentally by 10 and 100 in a problem-solving setting, and explains why the answer is correct					0-15			
O-15. multiplies whole numbers mentally by 10, 100 and 1 000 in a problem-solving setting, and explains why the answer is correct							.....	.....
O-16. divides whole numbers mentally by 10, 100 and 1 000 in a problem-solving setting, and explains why the answer is correct							.....	.....
O-17. demonstrates understanding of all the factors of whole numbers (limit: two-digit numbers) by connecting manipulatives, diagrams and symbols							.....	.....
O-18. estimates products in a meaningful context by using: <ul style="list-style-type: none"> <li>● rounding</li> <li>● compensation</li> </ul>						(two and three digits by one digit)	(limit: three-digit multipliers)	(any whole numbers)
O-19. multiplies whole numbers in a problem-solving setting by: <ul style="list-style-type: none"> <li>● using manipulatives and diagrams to develop a paper-and-pencil method</li> <li>● using a paper-and-pencil solution, and verifying it through the use of manipulatives and diagrams, where appropriate</li> </ul>						(two and three digits by one digit)	(limit: two-digit multipliers)	.....

## OPERATIONS AND PROPERTIES (continued)

### Multiplication and Division of Whole Numbers (continued)

	LEVELS							
	1	2	3	4	5	6	7	8
O-20. estimates quotients in a meaningful context by using compatible numbers and compensation								
O-21. divides whole numbers (with and without remainders) in a problem-solving setting by: <ul style="list-style-type: none"> <li>• using manipulatives and diagrams to develop a paper-and-pencil method</li> <li>• using a paper-and-pencil solution, and verifying it through the use of manipulatives and diagrams, where appropriate</li> </ul>						(two digits by one digit)	(limit: four digits by one digit)	(any whole numbers)
O-22. demonstrates understanding of the relationship between multiplication and division in a problem-solving setting by: <ul style="list-style-type: none"> <li>• using manipulatives and diagrams to develop related number sentences</li> <li>• generating related number sentences, and verifying them through the use of manipulatives and diagrams, where appropriate.</li> </ul>						(two digits by one digit)	(limit: four digits by one digit)	(limit: four digits by two digits)
<b>Properties</b> The student:								
O-23. exhibits awareness of the commutative property of addition through discussion associated with manipulatives and diagrams				O-24				
O-24. demonstrates understanding of the commutative property through discussion associated with manipulatives and diagrams				(addition)	(addition and multiplication)			



## OPERATIONS AND PROPERTIES (continued)

### LEVELS

	1	2	3	4	5	6	7	8
<b>Properties (continued)</b>								
O-25. demonstrates understanding of the unique effect of 0 and 1 in addition and multiplication by using manipulatives and diagrams in a problem-solving setting					_____	_____	_____	_____
O-26. demonstrates understanding of the associative property of addition and multiplication through discussion associated with manipulatives and diagrams						_____	_____	_____
O-27. demonstrates understanding of the distributive property through discussion associated with manipulatives and diagrams; e.g., $7 \times 8$ can be found by adding 7 fives and 7 threes.						_____	_____	_____
<b>Addition and Subtraction of Decimals</b>								
The student:								
O-28. estimates sums and differences of decimals to hundredths by using the front-end method, compensation and rounding in a meaningful context						_____	_____	_____
O-29. adds and subtracts decimals in a problem-solving setting by: <ul style="list-style-type: none"> <li>• using manipulatives and diagrams to develop a paper-and-pencil method</li> <li>• using a paper-and-pencil solution, and verifying it through the use of manipulatives and diagrams.</li> </ul>						(to hundredths)	(to thousandths)	_____

## LEVELS

## Multiplication and Division of Decimals

**The student:**

O-30. multiplies and divides decimals mentally by 10, 100 and 1 000 in a problem-solving setting, and explains why the answer is correct

**O-31.** estimates products of decimals multiplied by whole numbers, using rounding and compensation in a meaningful context

**O-32.** multiplies decimals (multiplicands to thousandths) by one- and two-digit whole number multipliers in a problem-solving setting by:

- using manipulatives and diagrams to develop a paper-and-pencil method
- using a paper-and-pencil solution, and verifying it through the use of manipulatives and diagrams, where appropriate

**O-33.** estimates quotients of decimals divided by whole numbers, using compatible numbers and compensation

**O-34.** divides decimals (dividends to thousandths) by one- and two-digit whole number divisors in a problem-solving setting by:

- using manipulatives and diagrams to develop a paper-and-pencil method
- using a paper-and-pencil solution, and verifying it through the use of manipulatives and diagrams, where appropriate.

[illegible]

## OPERATIONS AND PROPERTIES (continued)

	LEVELS							
	1	2	3	4	5	6	7	8
<b>Using the Calculator</b>								
The student:								
O-35. estimates and then adds, subtracts, multiplies and divides, using the calculator								
O-36. uses the constant feature of the calculator								
O-37. uses the memory feature of the calculator.								
<b>Application</b>								
The student:								
O-38. uses the terms: sum, difference, factor, product, divisor, dividend, quotient								
O-39. estimates and then calculates averages in a problem-solving setting by: <ul style="list-style-type: none"> <li>• using manipulatives and diagrams to develop the concept (paper-and-pencil/calculator)</li> <li>• verifying the solution (paper-and-pencil/calculator) through the use of manipulatives and diagrams, where appropriate</li> </ul>								
O-40. applies and practises the operations in a problem-solving setting by using mental calculation, a paper-and-pencil method or a calculator, where appropriate.				(addition and subtraction)	(the four operations)			

# MEASUREMENT

## LEVELS

	1	2	3	4	5	6	7	8
<b>Time</b>								
The student:								
M-1. exhibits awareness of terms denoting the passage of time:								
• now, not now								
• before, after, long time, short time, yesterday, today, tomorrow								
M-2. uses the terms related to time concepts: now, not now, before, after, long time, short time, yesterday, today, tomorrow								
M-3. uses terms (e.g., seconds, minutes, hours, days, weeks, months, years) to demonstrate understanding that time is divided into parts, some of which are longer or shorter than others								
M-4. recites and orders the days of the week								
M-5. reads dates on the calendar								
M-6. recites the months of the year in order								
M-7. orders the months of the year								
M-8. reads and writes time, using standard notation to the nearest:								
M-9. exhibits awareness of reading the 24-hour clock and writes corresponding time notation								
M-10. expresses equivalent measures of time.								
<b>Length</b>								
The student:								
M-11. appropriately uses the terms: big, small, tall, long, short								



# MEASUREMENT (continued)

## LEVELS

	1	2	3	4	5	6	7	8
<b>Length (continued)</b>								
M-12. compares and orders two or more objects according to length, height and thickness			M-14					
M-13. exhibits awareness of non-standard units of measure			M-14					
M-14. estimates, measures, compares and orders length, using:			(non-standard units)	(cm, m)	(cm, dm, m, km)	(mm, cm, dm, m, km)		
M-15. uses appropriate standard measuring units for length								
M-16. expresses equivalent linear measures by using manipulatives, where appropriate							(mm, cm, dm, m, km)	
M-17. expresses linear measures to the nearest tenth, hundredth and thousandth of a metre by using manipulatives, where appropriate								
M-18. expresses linear measures in expanded form by using manipulatives, where appropriate.								
<b>Capacity</b>								
The student:								
M-19. appropriately uses the terms: empty, full		M-20						
M-20. exhibits awareness of non-standard units of measure			M-21					
M-21. estimates and measures capacity, using:			(non-standard units)		(L)	(mL, L)		
M-22. compares the capacity as more than, less than or the same as, using:								
<ul style="list-style-type: none"> <li>two identical containers</li> <li>any two containers</li> <li>two or more containers, with units of measure</li> </ul>				(non-standard units)	(L)	(mL, L)		

## MEASUREMENT (continued)

### LEVELS

	1	2	3	4	5	6	7	8
<b>Capacity (continued)</b>								
M-23. uses appropriate standard measuring units for capacity								
M-24. expresses equivalent capacity measures by using manipulatives, where appropriate.								(mL, L, kL)
<b>Mass</b>								
The student:								
M-25. appropriately uses the terms: heavy, light		M-26						
M-26. exhibits awareness of non-standard units of measure			M-27					
M-27. estimates and measures mass, using:			(non-standard units)	(kg)	(kg)	(g, kg)		
M-28. compares the mass as heavier than, lighter than or the same as, using:								
<ul style="list-style-type: none"> <li>● two objects, with:</li> <li>● two or more objects, with units of measure</li> </ul>		(hands)	(balance scale)	(non-standard units)	(kg)	(g, kg)		
M-29. uses appropriate standard measuring units for mass						(g, kg)	(g, kg, t)	
M-30. expresses equivalent mass measures by using manipulatives, where appropriate.								(g, kg, t)
<b>Metric Prefixes</b>								
The student:								
M-31. demonstrates understanding of the relationship among the metric prefixes, as applied to the basic units: m, L, g. This includes the use of symbols: kilo (k), hecto (h), deca (da), deci (d), centi (c), milli (m).								

## MEASUREMENT (continued)

### LEVELS

	1	2	3	4	5	6	7	8
<b>Temperature</b>								
The student:								
M-32. uses the terms: hot, cold	_____	M-33						
M-33. compares two or more objects as hotter than, colder than or the same as, and sequences according to temperature	_____	_____	M-34					
M-34. reads two or more Celsius thermometers, and compares temperatures as hotter than or colder than			_____	M-35				
M-35. reads the Celsius thermometer, and uses the symbol °C				_____	.....	.....	.....	.....
M-36. determines the reasonableness of Celsius thermometer readings in given situations.						_____	.....	.....
<b>Measuring Instruments</b>								
The student:								
M-37. exhibits awareness of instruments used for measuring length, capacity, mass, time and temperature.			_____	.....	.....			
<b>Money</b>								
The student:								
M-38. exhibits awareness of the concept of exchange in relation to purchasing	_____	.....	.....	M-42				
M-39. recognizes pennies, nickels, dimes, quarters and the dollar coin, and states the value of each			_____	M-41				
M-40. gives equivalent values of coins up to and including 10 cents			_____	M-42				
M-41. counts collections of coins up to and including \$1 using dimes and pennies			_____	M-42				

# MEASUREMENT (continued)

## LEVELS

	1	2	3	4	5	6	7	8
<b>Money (continued)</b>								
M-42. counts collections, gives equivalent value and makes purchases up to and including:				(\$1 using dimes, nickels, pennies)	(\$10 using any coins and appropriate bills)	(any amount)		
M-43. makes change up to and including:					(\$10)	(any amount)		
<b>Perimeter, Area, Volume</b>								
The student:								
M-44. finds and compares the perimeter of polygons by using manipulatives and diagrams (no formulas) in a problem-solving setting								
M-45. uses manipulatives and diagrams (no formulas) in a problem-solving setting to find and compare the area of:								
<ul style="list-style-type: none"> <li>rectangles</li> <li>triangles</li> </ul>								
M-46. demonstrates understanding of the relationship between perimeter and area by using manipulatives and diagrams to make rectangles:								
<ul style="list-style-type: none"> <li>having the same perimeter but different areas</li> <li>having the same area but different perimeters</li> </ul>								
M-47. finds and compares the volume of rectangular solids by using manipulatives and diagrams (no formulas) in a problem-solving setting								
M-48. explores the relationship between the volume and the dimensions of rectangular solids by constructing rectangular solids that have the same volume but different dimensions.								







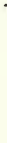


# **MEASUREMENT** (continued)

## **LEVELS**



	1	2	3	4	5	6	7	8
<b>Angles</b>								
The student:								
M-49. estimates the measure of an angle. Measures and constructs angles by using a protractor.								
<b>Application</b>								
The student:								
M-50. applies measurement concepts in solving and creating real-life problems.								

# GEOMETRY

## LEVELS

	1	2	3	4	5	6	7	8
<b>Spatial Relationships</b> The student:								
G-1. identifies the spatial relationships: <ul style="list-style-type: none"> <li>inside, outside, in front of, behind, on, under, up, down, here, there</li> <li>over, above, below, between, near</li> </ul>			G-2					
G-2. describes the spatial relationships, using the terms: inside, outside, in front of, behind, on, under, up, down, here, there, over, above, below, between, near.								
<b>Patterns</b> The student:								
G-3. exhibits awareness of patterns, using three-dimensional objects and two-dimensional figures: <ul style="list-style-type: none"> <li>identifies and creates patterns</li> <li>reproduces and extends a simple pattern</li> </ul>			G-4					
G-4. demonstrates understanding of patterns, using three-dimensional objects and two-dimensional figures: <ul style="list-style-type: none"> <li>identifies and creates patterns</li> <li>reproduces and extends patterns</li> <li>compares the similarities and differences among patterns.</li> </ul>						G-17		
<b>Classification of Three-dimensional Objects and Two-dimensional Figures</b> The student:								
G-5. classifies three-dimensional objects from the physical world according to attributes and describes these attributes by: <ul style="list-style-type: none"> <li>using terms, such as boxes, balls, cans, cones, etc.</li> </ul>								

## GEOMETRY (continued)

Classification of Three-dimensional Objects and Two-dimensional Figures (continued)	LEVELS							
	1	2	3	4	5	6	7	8
<ul style="list-style-type: none"> <li>creating at least two different ways to sort the objects</li> <li>identifying vertices, edges, faces and curved surfaces</li> <li>relating objects to models of spheres, cylinders, cones, prisms, pyramids</li> </ul>			_____	_____				
				_____				
				_____	G-8			
G-6. classifies and names two-dimensional figures as circles, squares, triangles or rectangles by:								
• using objects from the physical world			_____					
• using diagrams that include a wide variety of sizes, shapes and orientations of each type			_____					
• using sets that include non-examples, such as ovals and figures that contain four sides (e.g.,  or more than four sides			_____					
• using sets of any two-dimensional figures containing non-examples, which may have one or more curves; e.g., 				_____				
• using the tracings of the faces of three-dimensional objects				_____				
• identifying vertices (corners), sides and curves				_____				
• describing the essential attributes					_____			
G-7. classifies and names two-dimensional figures as pentagons, hexagons, octagons							_____	

## GEOMETRY (continued)

### LEVELS

	1	2	3	4	5	6	7	8
<b>Classification of Three-dimensional Objects and Two-dimensional Figures (continued)</b>								
G-8. classifies three-dimensional objects by:								
• using objects to name prisms, pyramids, cones, cylinders, spheres								
• using nets to name:								
- prisms, pyramids								
- cylinders, cones								
• using objects or nets to name prisms and pyramids according to the types of bases; e.g., triangular prisms								
• describing the essential attributes of prisms, pyramids, cones, cylinders, spheres								
G-9. classifies and names line segment, line, ray, angle								
G-10. classifies and names angles as acute, right, obtuse, straight								
G-11. classifies and names lines as intersecting, parallel.								
<b>Construction</b>								
The student:								
G-12. constructs three-dimensional objects:					(prisms, spheres)	(prisms, spheres, pyramids)	(prisms, spheres, pyramids, cones, cylinders)	
G-13. constructs two-dimensional figures (3, 4, 5, 6 and 8 sides)								



# GEOMETRY (continued)

## LEVELS

	1	2	3	4	5	6	7	8
<b>Construction (continued)</b>								
G-14. constructs a circle, and: <ul style="list-style-type: none"> <li>identifies and draws the radius and diameter</li> <li>identifies the circumference.</li> </ul>								
<b>Symmetry and Motion Geometry</b>								
The student:								
G-15. exhibits awareness of symmetry				G-16				
G-16. demonstrates understanding of symmetry through: <ul style="list-style-type: none"> <li>folding and cutting</li> <li>identifying symmetric figures and drawing lines of symmetry on two-dimensional figures</li> </ul>								
G-17. demonstrates understanding of translations (slides) and reflections (flips) by: <ul style="list-style-type: none"> <li>manipulating two-dimensional figures</li> <li>drawing and identifying translations (slides) of two-dimensional figures</li> </ul>								
G-18. demonstrates understanding of rotations (turns) by: <ul style="list-style-type: none"> <li>manipulating two-dimensional figures</li> <li>drawing and identifying rotations (turns) of two-dimensional figures.</li> </ul>								

## DATA MANAGEMENT

### LEVELS

	1	2	3	4	5	6	7	8
<b>Collecting and Recording Data</b>		(teacher guided)						
<u>First-hand Information</u>								
The student:								
D-1. creates classifications for data collected								
D-2. counts objects								
D-3. conducts polls								
D-4. conducts experiments								
D-5. uses measuring devices			(non-standard units)	(cm, m)	(cm, dm, m, km, L, kg)	(mm, cm, dm, m, km, mL, L, g, kg)		
D-6. uses tallies								
D-7. designs and uses questionnaires in conducting a poll.								
<u>Second-hand Information</u>								
The student:								
D-8. extracts data from sources, such as tables, lists, visuals and printed resources that are:								
• given								
• researched								
D-9. recognizes the difference between first-hand data and second-hand data.								
<b>Organizing and Displaying Data</b>								
The student:								
D-10. uses rank ordering								
D-11. uses class intervals in frequency distributions, where appropriate								
D-12. represents experience in various ways; e.g., drawings, block constructions		D-13						

## DATA MANAGEMENT (continued)

### LEVELS

	1	2	3	4	5	6	7	8
<b>Organizing and Displaying Data (continued)</b>								
D-13. constructs graphs:								
• concrete graphs		(teacher guided)						
• pictographs								
• bar graphs								
• double bar graphs								
• line graphs								
D-14. places an object on a grid, and describes the position of an object on a grid by referring to columns and rows				(1 to 1 correspondence)	(1 to 1, 2 to 1, 5 to 1, 10 to 1)	(1 to 1, 2 to 1, 5 to 1, 10 to 1, 50 to 1, 100 to 1)	(1 to 1, 2 to 1, 5 to 1, 10 to 1, 50 to 1, 100 to 1, 1 000 to 1)	
D-15. graphs ordered pairs, and writes the coordinates as ordered pairs (first quadrant only)					D-15			
D-16. distinguishes among the types of graphs and discusses reasons for using each type of graph								
D-17. draws tree diagrams.								
<b>Interpreting Displayed Data</b>								
The student:								
D-18. discusses data, using appropriate terms:								
• more, less, the same as								
• fewer, most, least, altogether								
• how many more, how many fewer								
• what fraction of (emphasis on halves, thirds, quarters, fifths, tenths, hundredths)								

## DATA MANAGEMENT (continued)

### LEVELS

	1	2	3	4	5	6	7	8
<b>Interpreting Displayed Data (continued)</b>								
D-19. demonstrates understanding of the chance component of probability by using the terms: <ul style="list-style-type: none"> <li>● always, never, sometimes, maybe</li> <li>● probably, likely, unlikely, more likely, less likely</li> </ul>								
D-20. identifies events: <ul style="list-style-type: none"> <li>● impossible, certain, uncertain</li> <li>● equally likely, unequally likely</li> </ul>						(limit: 2 events)	(2 or more events)	
D-21. interprets the results of probability experiments to show that they are not influenced by the knowledge, experience, age or skill of the experimenter								
D-22. compares two probability experiments with common events, and identifies which experiment would more likely yield a specified event; e.g., choosing a yellow bead from two different sets of yellow and blue beads								
D-23. uses a fraction to describe the probability of an event from: <ul style="list-style-type: none"> <li>● experimental data</li> <li>● theoretical data, using all possible outcomes</li> </ul>								
D-24. uses data in solving and creating problems.								



## D. BASIC LEARNING RESOURCES

The basic resources for mathematics are listed in alphabetical order. Each resource usually addresses one main level but also provides for learning in other levels. The main level for each resource is marked by an asterisk (★) and dots (●) indicate the other relevant levels.

BASIC LEARNING RESOURCES [ ] denotes publisher's designation of grade or level	Levels of Mathematics									
	►	1	2	3	4	5	6	7	8	►
<i>Early Explorations in Mathematics and Science</i> , Addison Wesley, 1992. (Teacher Resource) [Early Childhood]		●	★	●						
<i>Explorations</i> , Addison Wesley. (Teacher Resource)										
<i>Explorations for Early Childhood</i> , 1988. [Early Childhood]		●	★	●						
<i>Explorations 1</i> , 1986. [Grade 1]			●	★	●					
<i>Explorations 2</i> , 1987. [Grade 2]				●	★	●				
<i>MathQuest</i> , Addison Wesley. (Student Text)										
<i>MathQuest 3</i> , 1986. [Grade 3]					●	★	●			
<i>MathQuest 4</i> , 1987. [Grade 4]						●	★	●		
<i>MathQuest 5</i> , 1987. [Grade 5]							●	★	●	
<i>MathQuest 6</i> , 1987. [Grade 6]								●	★	
<i>MathWorks</i> , Houghton Mifflin. (Teacher Resource)										
<i>MathWorks, Book A</i> , 1992. [Grade 1]			●	★	●					
<i>MathWorks, Book B</i> , 1992. [Grade 2]				●	★	●				



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